TEAM ID: PNT2022TMID32816

PROJECT NAME: SMARTFARMER - IoT enabled smart farming applications

PROJECT REPORT

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1.INTRODUCTION:

1.1. Project overview:

In this project we have developed a mobile application and a web application using which a farmer can monitor the temperature, humidity, pH and soil moisture parameters along. Based on these details he can water the crops by controlling the motors through the app and web, the app gives an alert message if the moisture level goes beyond a threshold value.

1.2. Purpose:

Agriculture plays a crucial role in the life of an economy. It is the backbone of our economic system, so improving the quality and way of production is crucial. Smart agriculture helps in automated farming, collection of data from the field and then analyses it so that the farmer can make accurate decision in order to grow high quality crop. IoT based Smart Farming improves the entire Agriculture system by monitoring the field in real-time. With the help of sensors and interconnectivity, the Internet of Things in Agriculture has not only saved the time of the farmers but has also reduced the extravagant use of resources such as Water and Electricity.

2.LITERATURE SURVEY:

2.1. Survey:

The system presented by [1] aims at adopting IoT in agriculture to exploit automation approach. Monitoring environmental factors plays a vital role to increase the production of the efficient crops. Two most important natural factors are considered in this study namely temperature and humidity of the field. Humidity sensor sense the water in air. The proposed system consists of temperature (TMP007) & humidity (HDC1010) sensors and CC3200 single chip. The CC3200 is a cheap and faster programmable Wi-Fi MCU that enables true, integrated IoT development. If sensor sense abnormal reading, it transmits field information about the temperature, humidity to famers. A camera is linked with this chip to take images and send to farmers via MMS and subsequently the farmer will take appropriate action. [2] Exploits the LM35 temperature sensor and soil moisture sensor that is deployed in field and used to monitor the water supplements. [3] proposed a system comprises of LM35 temperature sensor, moisture sensor, RPi 3 model B, IC 3208 converter, relay and a buzzer. A threshold value 2.4v is set for soil moisture; this may vary from crop to crop. If the value is found less than the set threshold (2.4v in this case) the soil is classified as dry and signal is sent to turn on the water pump. Otherwise Soil is classified as wet and motor will be turned OFF. The data acquire from sensors are ingested to the cloud and can be accessible to farmer via his/her mobile/PC. The system let the farmer when to turn ON/OFF the water pump. The aim of the investigation presented in [4] is to decrease the loss of water, labour and improve the productivity. Moisture sensor is used to sense the content of moisture in soil and sends moisture sensor information to Arduino. Moisture sensor is used to detect moisture in the soil. It works on the principle of open and short circuit. When the soil is dry the circuit behaves like an open circuit and close if the soil is wet. Wi-Fi module is used for communication to transmit data from sensor layer to the cloud. Data collected from moisture sensor is fed into Arduino and Arduino upload this information or values on cloud by using Wi-Fi. Threshold value is set according to the crop's need. Moisture level checked with respect to predefined threshold value. The threshold value is different for different crops. If the moisture value is less than the reference value pump is ON otherwise remains OFF. This helps in reduction of water usage. [4] Proposed an innovative smart IoT based Stick equipped with temperature and moisture sensors, providing real time sensor data to famers on handheld device. The purpose of the study carried in [4] is to provide cost effective solution to increase the productivity. The stick equipped with Arduino Mega 2560 augmented with moisture sensor and temperature sensor to monitor temperature and moisture powered by solar panel as well as battery (2200mAh; 11.2V). The stick works as a plug and play manner, it starts transmitting live information to cloud through ESP8266 Wi-Fi module as it is placed into a field. The cloud data is accessible to a hand-held device like mobile cellular phone, tablet or laptop. The obtained data can easily be shared with some expert remotely via cloud. The arrangement assists famers by providing precise live feed of environmental temperature and soil moisture to increase the yield and take effective consideration of food production. The proposed system is tried on Live Agriculture fields giving high accuracy over 99% in data feeds.

2.2. References

[1] Prathibha S., Hongal A., and Jyothi M. (2017). IOT Based Monitoring System in Smart Agriculture. 2017 International Conference on Recent Advances in Electronics And Communication Technology (ICRAECT). doi: 10.1109/icraect.2017.52.

[2] Rao R., and Sridhar B. (2018). IoT based smart crop-field monitoring and automation irrigation system. 2Nd International Conference on Inventive Systems and Control (ICISC). doi: 10.1109/icisc.2018.8399118.

[3] Mishra D., Khan A., Tiwari R., and Upadhay S. (2018). "Automated Irrigation System-IoT Based Approach". 3rd International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU). Available: https://ieeexplore.ieee.org/document/8519886 [Accessed 25 November 2019].

[4] Nayyar A. and Puri V. (2016). Smart farming. Communication and Computing Systems.

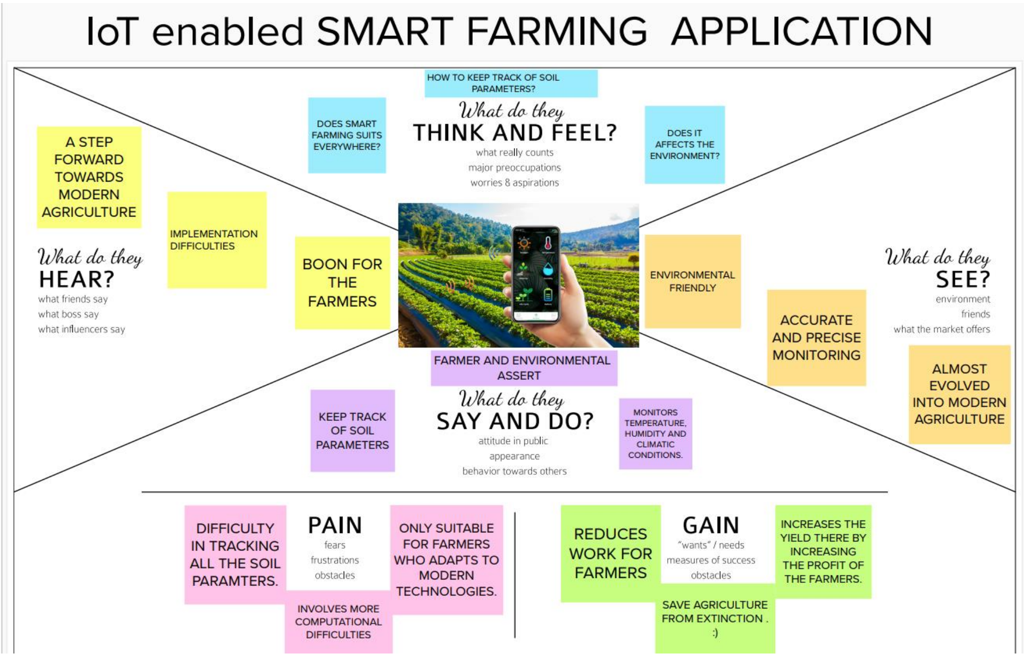
2.3. Problem statement definition

Who does the problem affect?	Persons who do Agriculture.
What are the boundaries of the problem?	People who Grow Crops and facing Issues in monitoring and watering plants.
What is the issue?	In agricultural aspects, if the plant is not provided with sufficient water, the production of the crop will be affected to a great extent. Providing correct amount of water is a challenge for the farmers.
When does the issue occur?	When the weather condition is uncertain, it is difficult to decide whether to water the crop or not.
Where does the issue occur?	The issue occurs in agriculture practising areas, particularly in rural regions.
Why is it important that we fix the problem?	It is required for the growth of better quality food products. It is important to maximise the crop yield
What solution to solve this issue?	This could be solved by monitoring the soil parameters, weather and climatic conditions and helping the farmer to make the correct decision.

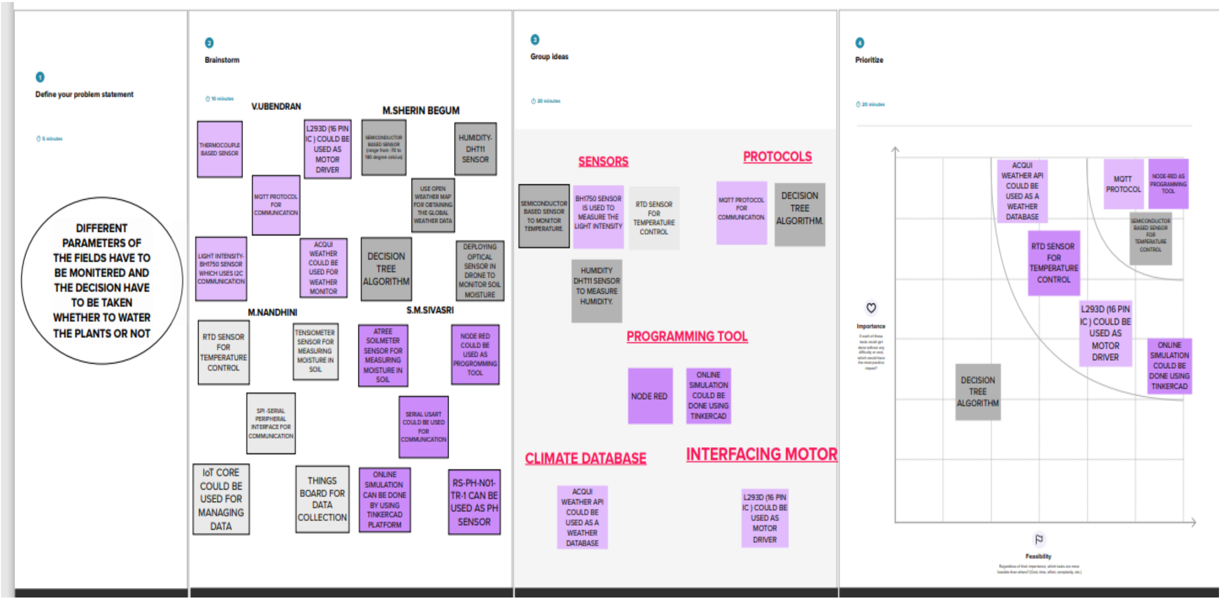
What methodology used to solve the issue?	Sensors, Weather API and mobile application could be used. The sensor values and weather data are used for the computation and the final decision whether to water the crop or not is taken using mobile application

3.IDEATION & PROPOSED SOLUTION

3.1Empathy Map Canvas



3.2. Ideation and brainstorming

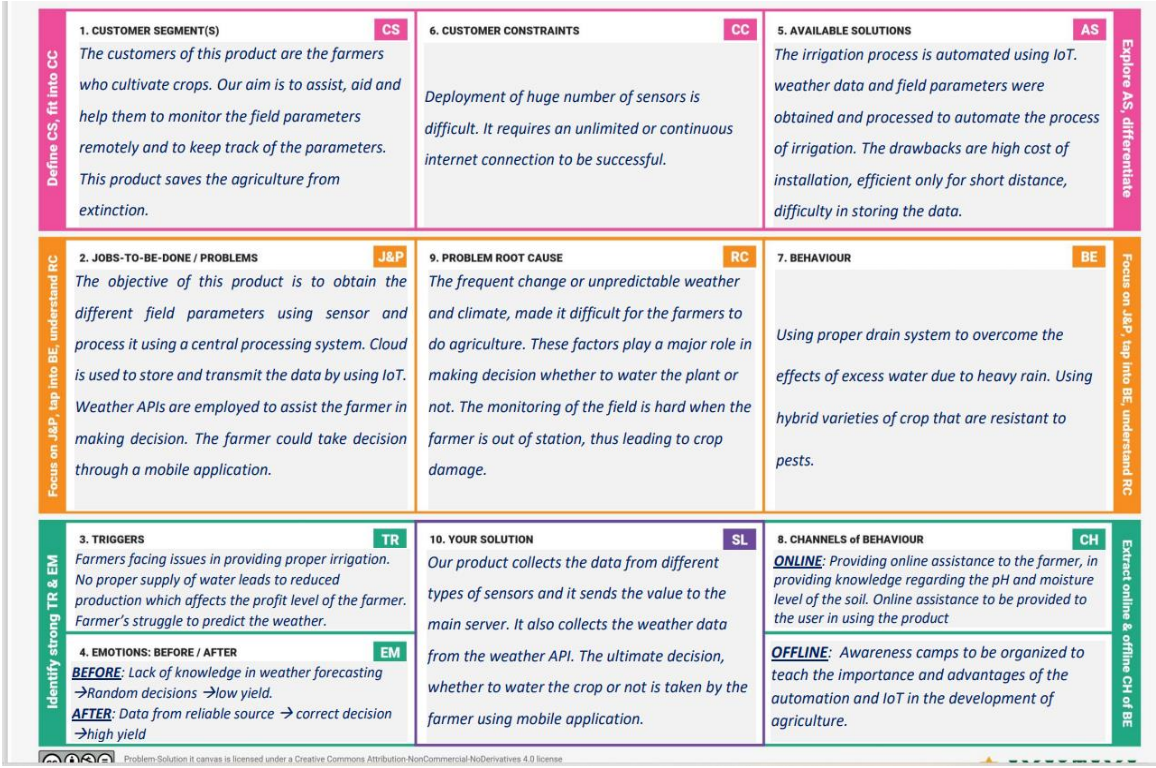


3.3. Proposed Solution

S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	In agriculture, there are two major problems one is unpredictable climate change and another one is the yields of the crops that have been damaged by improper irrigation. Our project will give the solution to overcome these problems with help of IOT.
2.	Idea / Solution description	It collects the data from different types of sensors and it sends the value to the main server. It also collects the weather data from the weather API. The ultimate decision, whether to water the crop or not

		is taken by the farmer using mobile application.
3.	Novelty / Uniqueness	It depends on IOT thus eliminating the need of physical work of farmers and thus increasing the productivity in every possible manner. The weather data are taken from the reliable source.
4.	Social Impact / Customer Satisfaction	The informations collected are from reliable sources and hence the farmer could make more precise decision, thereby the productivity increases.
5.	Business Model (Revenue Model)	Smart farming is an advanced and innovative way to get maximum cultivation and minimize the human efforts.
6.	Scalability of the Solution	Automatic farming equipment adjustment is made feasible by integrating information such as crops/weather and equipment to automatically alter temperature, humidity, and so on. With the use of sensors, it has enabled farmers to reduce waste and increase output.

3.4. Problem Solution fit



4.REQUIREMENT ANALYSIS

4.1. Functional Requirements:

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	End users can monitor and control their connected farm using IOT applications on their smartphones or tablets
NFR-2	Security	The software keeps the user's information more securely.
NFR-3	Reliability	The smart farm, embedded with IOT systems, could be called a connected farm, which can support a wide range of devices from diverse agricultural device manufactures.
NFR-4	Performance	It is a user-friendly software and have high performance.

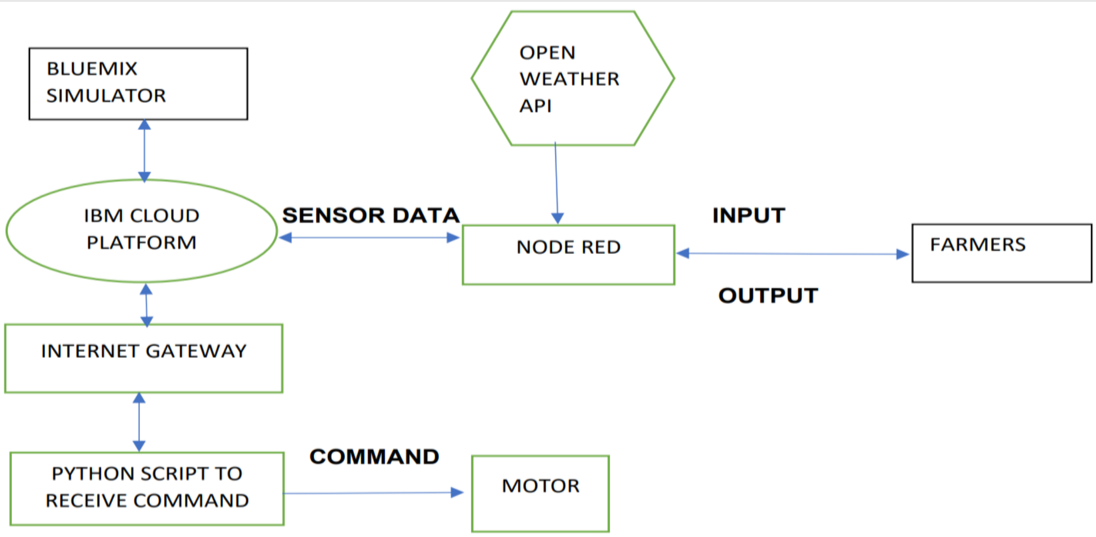
NFR-5	Availability	Available for every user, visible for all users and farmer.

4.2. Non functional Requirement

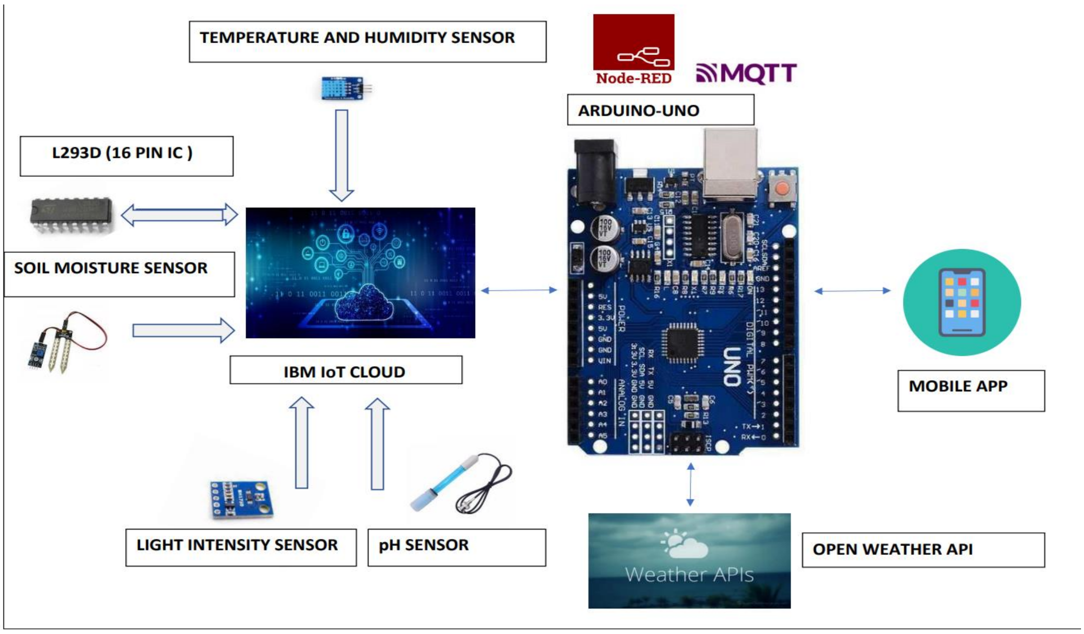
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Application.
FR-2	User Confirmation	Confirmation of registered user.
FR-3	User Profile	Log in Access the Profile
FR-4	Analyse	Data from smart sensors can be analysed for predictive analysis and automated decision making.
FR-5	Recommend	Based on the farming the software recommends the automated irrigation practices.
NFR-6	Scalability	The proposed precision farming structure allows the implementation of a flexible methodology that can be adopted to different types of crops.

5.PROJECT DESIGN

5.1 Data Flow Diagrams



5.2. Solution & Technical Architecture



5.3. User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my Username , password, and confirming my password.	I can access my account / dashboard	Low	Sprint-1
	Login	USN-2	As a user, I can log into the application by entering User name & password	Log in to application.	High	Sprint-1
	Dashboard	USN-3	By entering correct password, I could access the dashboard	Once logged in, User could the data.	Medium	Sprint-2

	Alert message	USN-4	As a user, I receive alert message regarding the field parameters.	After successful log in, user will receive alert messages.	High	Sprint-3
	Data Storage	USN-5	As a user, I will be able to store parameter values.	Using IBM cloud the data could be stored.	High	Sprint-4
	Decision	USN-6	As a user, I can operate motor remotely using the mobile application.	Using the mobile application, I can operate motor remotely	High	Sprint-4
Customer (Web user)	Login	USN-7	As a user, I can log in to the application.	Log in to application	High	Sprint-1
	Dashboard	USN-8	I could access the dashboard	Once logged in, User could the data	Medium	Sprint-1
	Alert message	USN-9	As a user, I receive alert message regarding the field parameters.	After successful log in, user will receive alert messages.	High	Sprint-3
	Data Storage	USN-10	As a user, I will be able to store parameter values.	The data could be stored.	High	Sprint-4
	Decision	USN-11	As a user, I can operate motor remotely using the mobile application	Using the mobile application, I can operate motor remotely	High	Sprint-4

6.PROJECT PLANNING & SCHEDULING

6.1. Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration (Mobile user)	USN-1	As a user, I can register for the	1	Low	UBENDRAN.V ,

			application by entering my Username , password, and confirming my password.			SHERIN BEGUM.M
Sprint-1	Login (Mobile user)	USN-2	As a user, I can log into the application by entering User name & password	3	High	NANDHINI.M, SIVASRI.S.M
Sprint-2	Dashboard (Mobile user)	USN-3	By entering correct password, I could access the dashboard	13	Medium	UBENDRAN.V
Sprint-3	Alert message (Mobile user)	USN-4	As a user, I receive alert message regarding the field parameters.	13	High	UBENDRAN.V , SHERIN BEGUM.M
Sprint-4	Data Storage (Mobile user)	USN-5	As a user, I will be able to store parameter values.	2	High	UBENDRAN.V , SHERIN BEGUM.M
Sprint-4	Decision (Mobile user)	USN-6	As a user, I can operate motor remotely using the mobile application.	8	High	NANDHINI.M, SIVASRI.S.M
Sprint-1	Login (web user)	USN-7	As a user, I can log in to the application.	13	High	UBENDRAN.V , SHERIN BEGUM.M
Sprint-1	Dashboard (web user)	USN-8	I could access the dashboard	3	Medium	NANDHINI.M, SIVASRI.S.M
Sprint-3	Alert message (web user)	USN-9	As a user, I receive alert message regarding the field parameters.	5	High	UBENDRAN.V , SHERIN BEGUM.M
Sprint-4	Data Storage (web user)	USN-10	As a user, I will be able to store	2	High	UBENDRAN.V , SHERIN

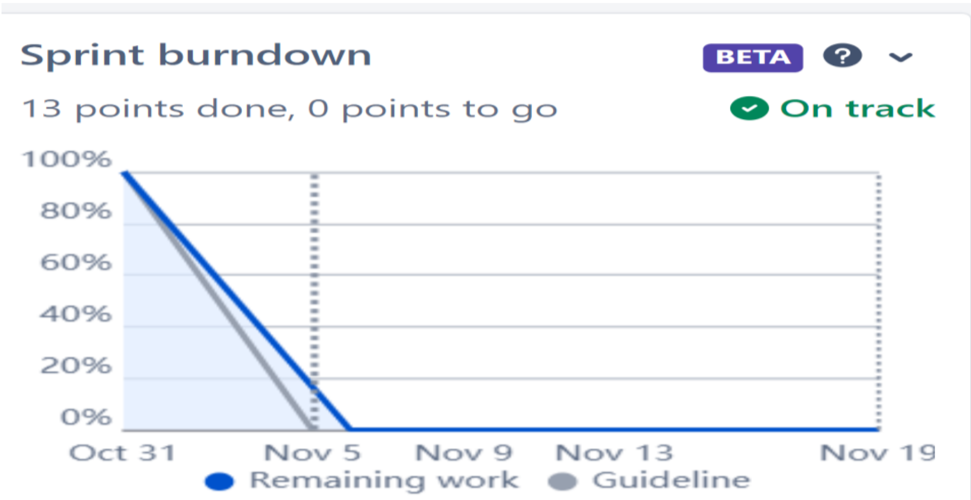
			parameter values.			BEGUM.M
Sprint-4	Decision (web user)	USN-11	As a user, I can operate motor remotely using the mobile application	8	High	NANDHINI.M, SIVASRI.S.M

6.2. Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	29 Oct 2022
Sprint-2	13	6 Days	31 Oct 2022	05 Nov 2022	
Sprint-3	18	6 Days	07 Nov 2022	12 Nov 2022	
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	

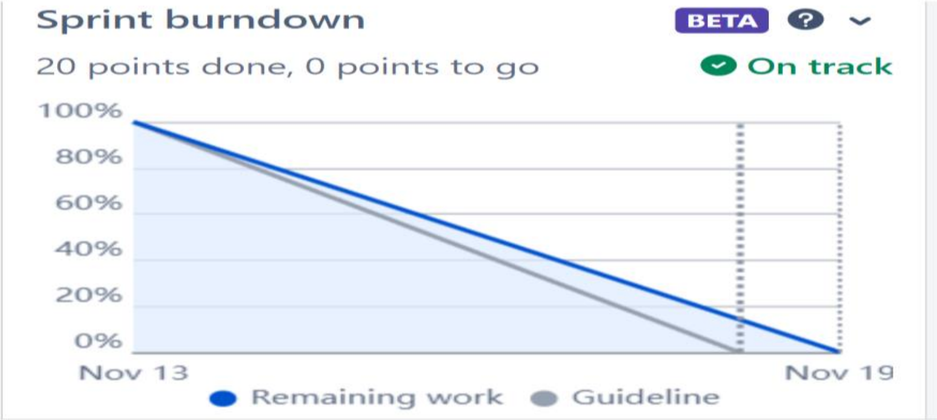
6.3 . Reports from JIRA:

Sprint 2:



Sprint 3:

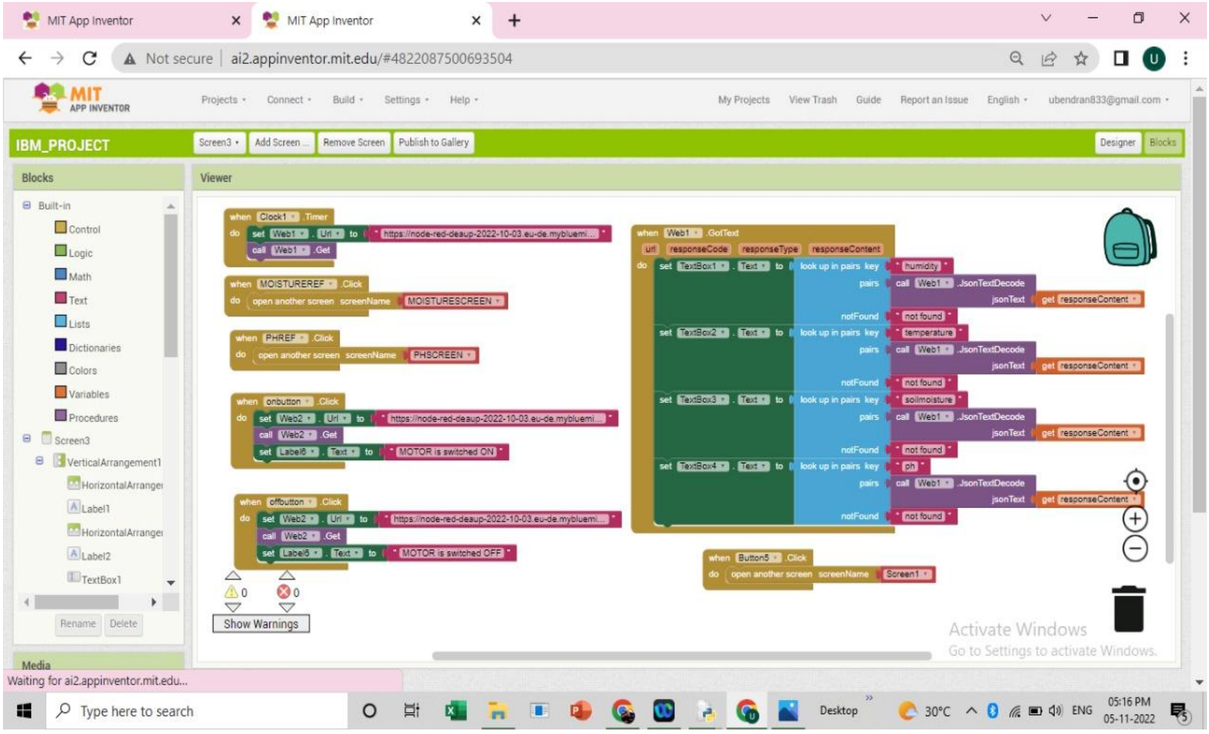
Sprint 4:



7.CODING & SOLUTIONING

7.1.MIT app inventor

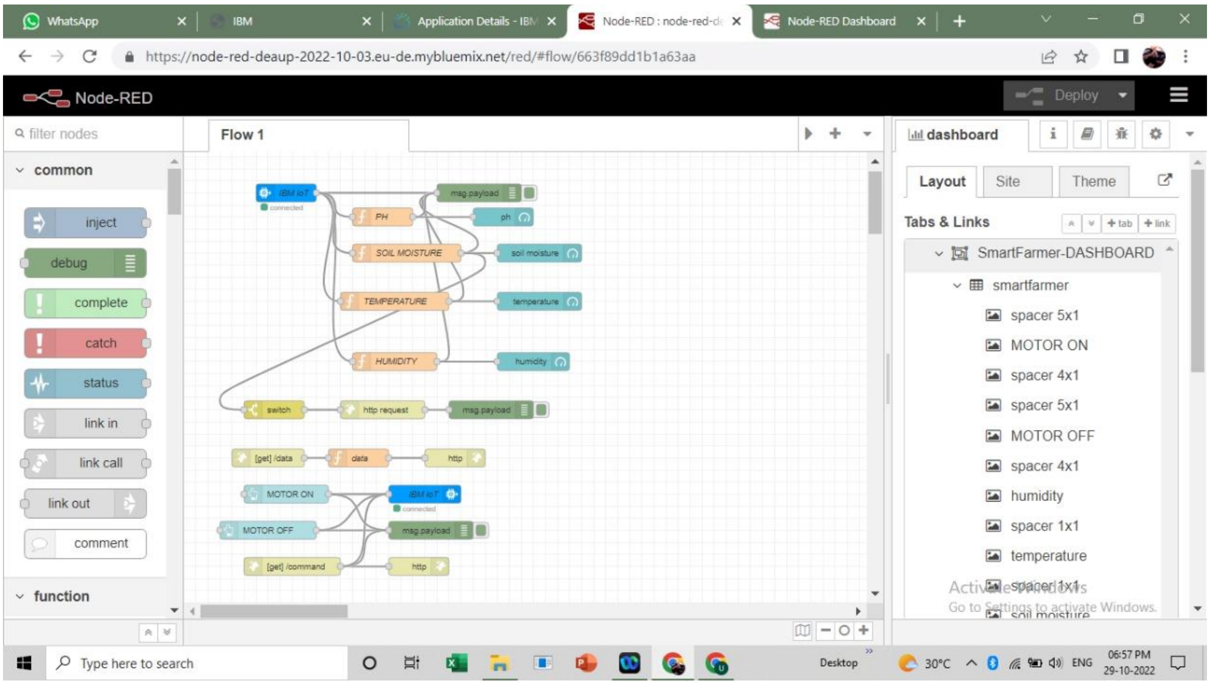
The is designed in such a way that the user need to register In order to access the dashboard. Only the authenticated user will be allowed to access the dashboard. This is made possible by using firebase. The mobile app is created using MIT app inventor. The parameter values to be monitored are generated using python code. The generated value is stored in IBM cloud. The values are given to node red from node red the mobile application gets the value. The user could turn on/off the motor using the application. If the moisture level is less than the prescribed value the user will get an alert message .This is made possible by incorporating node red and twilio.



7.2. Web Application

The web application is created using node red. The parameter values are displayed to the user in a graphical manner. The user could turn on/off the motor using the application.

The below figure gives the node red connection to get data from cloud and to use that data in app and web application.



8.TESTING

8.1. Test cases

Test Scenarios

- Verify user is able to see login page
- Verify user is able to loginto application or not?
- Verify user is able to navigate to create your account page?
- Verify user gets the sensor values in the app/web?
- Verify user able to log off?
- Verify user able to operate the motor through app/web?

8.2. User Acceptance Testing

Test case analysis:

Section	Total Cases	Not Tested	Fail	Pass
User friendly	4	0	0	4
SMS are received	25	0	1	24
Security	2	0	0	2
Control to motor	3	0	0	3
Accuracy	5	0	0	5
Final Report Output	4	0	0	4

Defect analysis:

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
External	2	0	0	1	3
Fixed	1	2	1	1	5
Not Reproduced	0	0	1	0	1
Skipped	1	1	0	0	2
Won't Fix	0	0	2	1	3
Totals	4	3	4	3	28

9.RESULTS

9.1. Performance Metrics

NIT Risk assesment

S.No	Project Name	Scope/feature	Functional changes	Hardware changes	Software changes	volume changes
1	IOT-ENABLED-SMART-FARMING-APPLICATION	Agriculture	Low	No changes	Low	No changes
2	IOT-ENABLED-SMART-FARMING-APPLICATION	smart grid	No changes	Moderate	No changes	Low
3	IOT-ENABLED-SMART-FARMING-APPLICATION	water supply	Low	No changes	Moderate	Moderate
4	IOT-ENABLED-SMART-FARMING-APPLICATION	Temperature	No changes	Low	No changes	Moderate
5	IOT-ENABLED-SMART-FARMING-APPLICATION	Humidity	low	No changes	Low	No changes

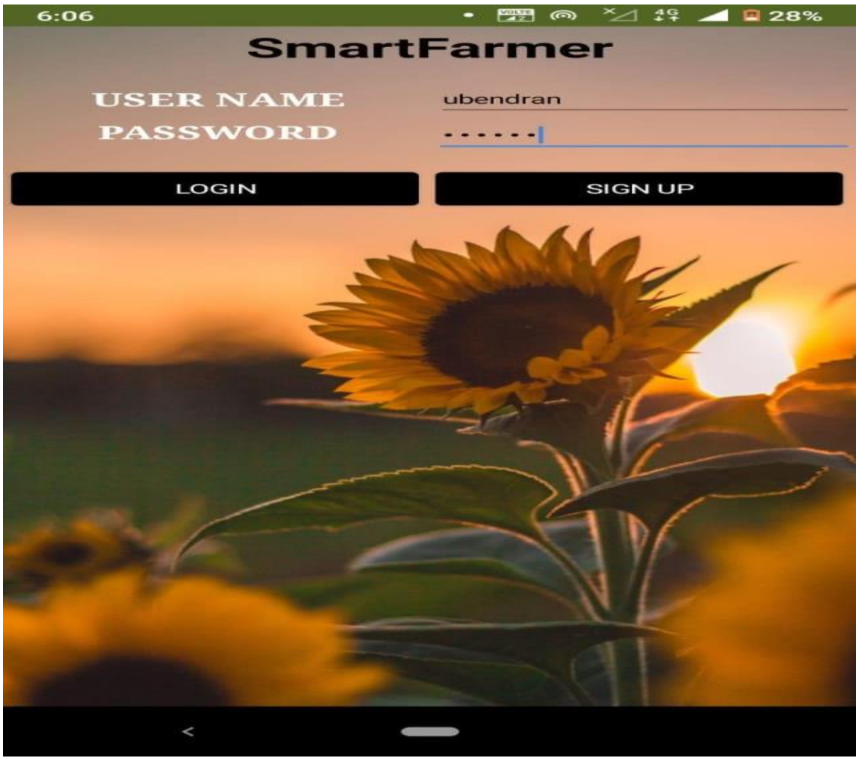
NIT-Detailed test plan

S.No	project overview	NFT test approach	Assumption/dependencies/Risks	Approval/Signoff
1	IOT weather reporting system	Tests the weather condition	Weather	Edge capabilities
2	Weather monitoring using temperature sensor	Temperature is monitored	Temperature	Network security
3	Weather monitoring using humidity sensor	Humidity is monitored	Humidity	Device security

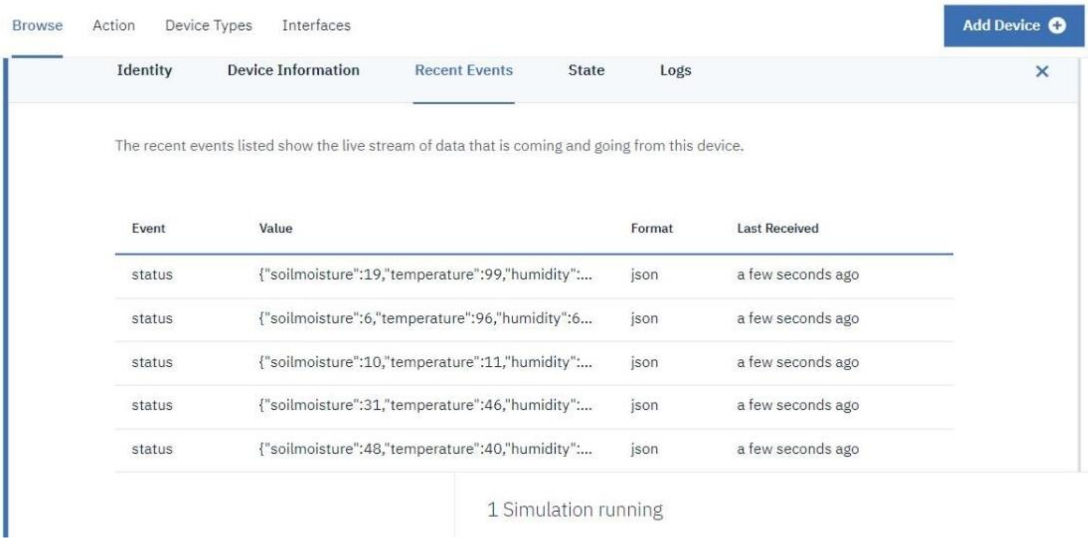
End of test report

S.No	project overview	NFT test approach	Assumption/dependencies/Risks	NFR.Met	Test outcome	Recommendation
1	IOT weather reporting system	Tests the weather condition	Weather	Privacy interoperability	Access weather conditions	Designing techniques
2	Weather monitoring using temperature sensor	Temperature is monitored	Temperature	Performance	specify the temperature	Developind devices
3	Weather monitoring using humidity sensor	Humidity is monitored	Humidity	Maintainability	Trace the humidity level	Developing sensor

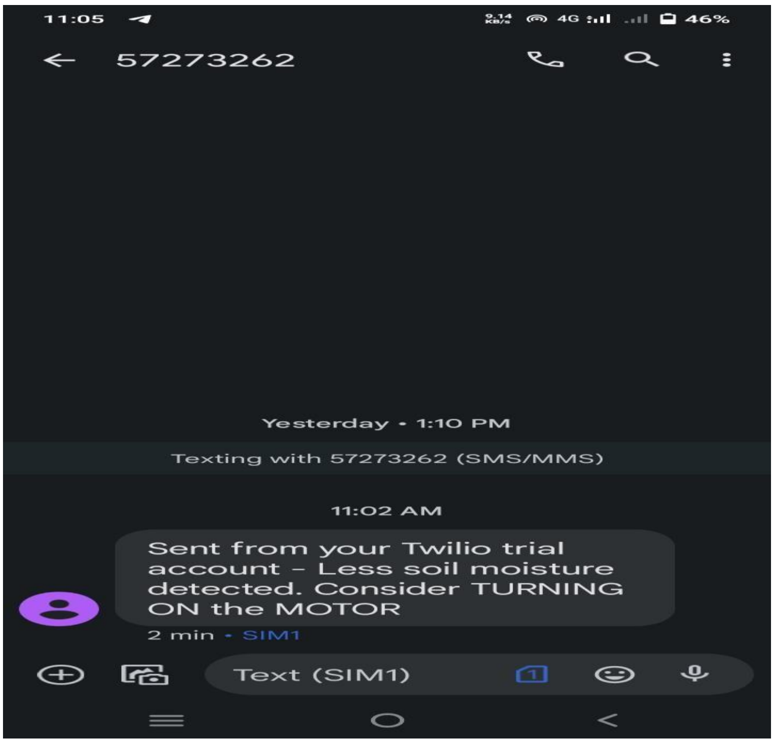
Login page:



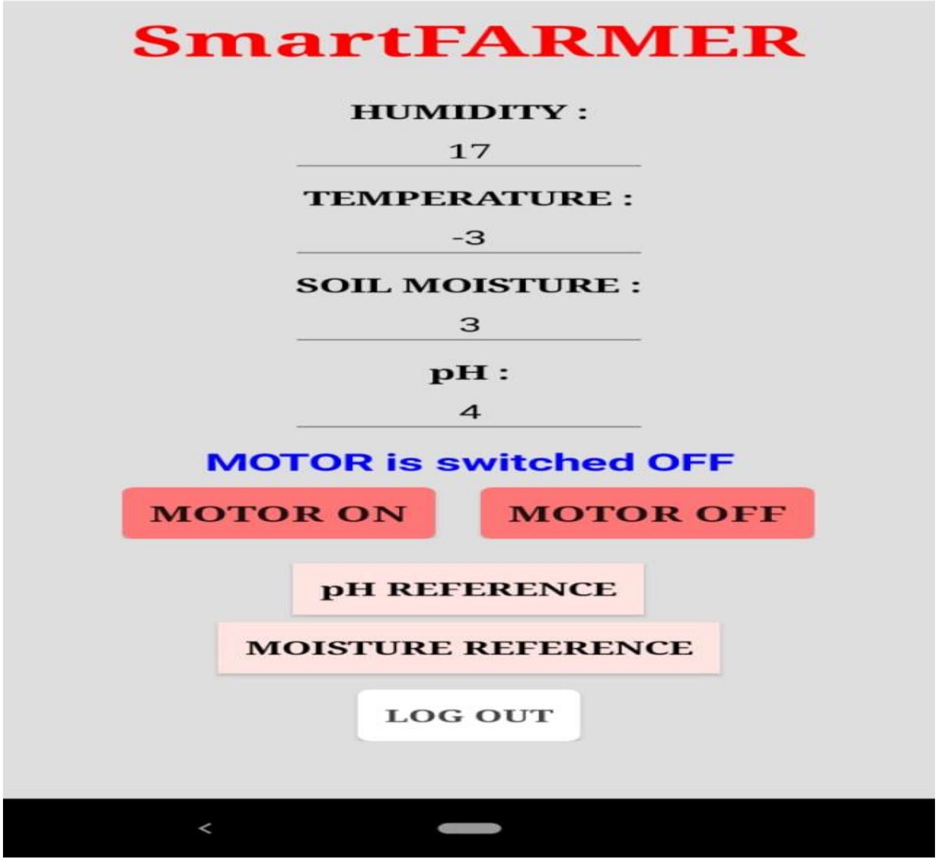
Storing values in IBM cloud:



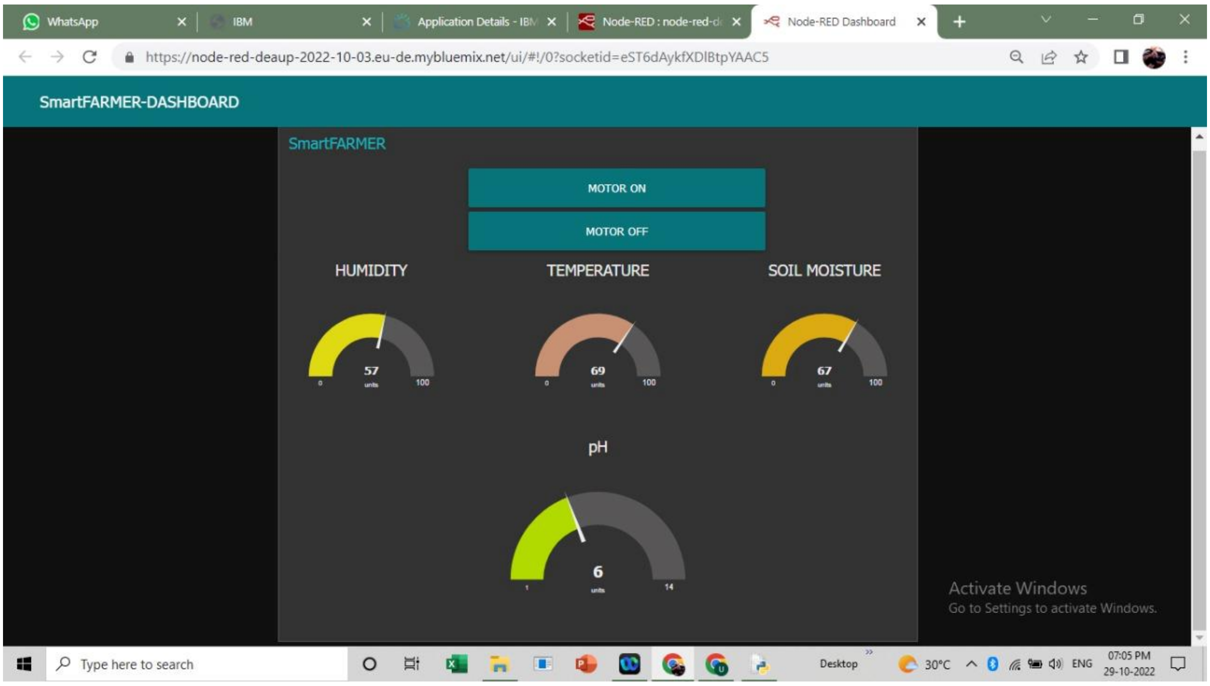
Alert message:



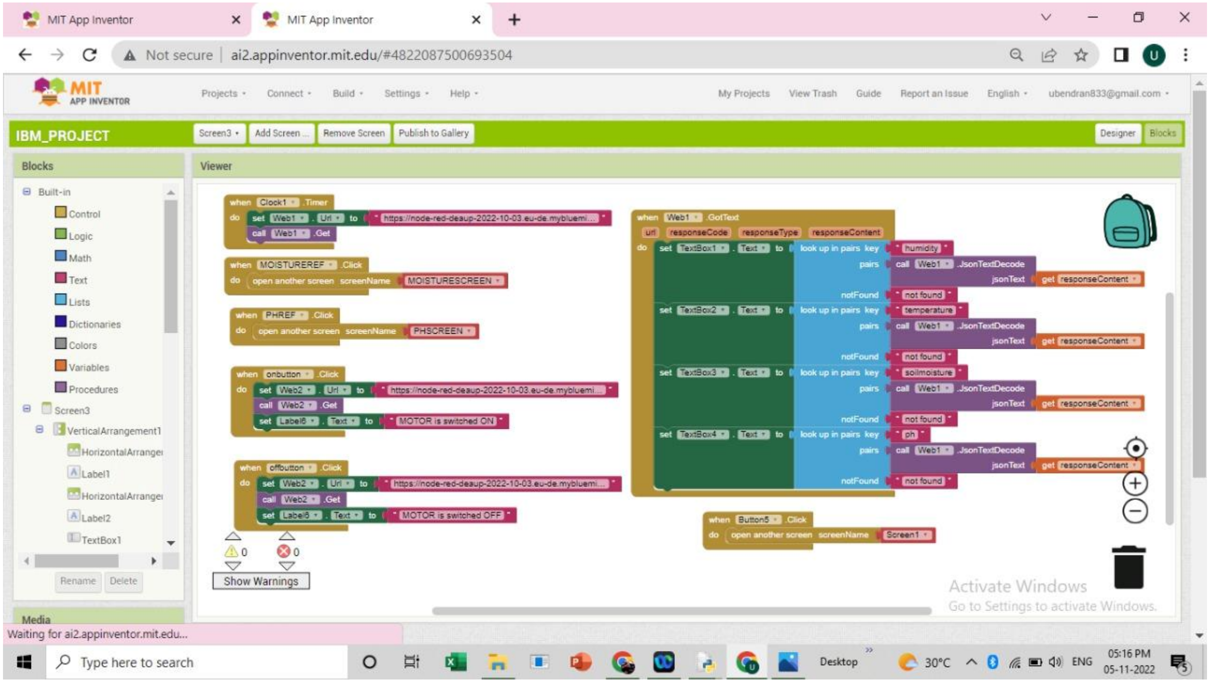
Dashboard:



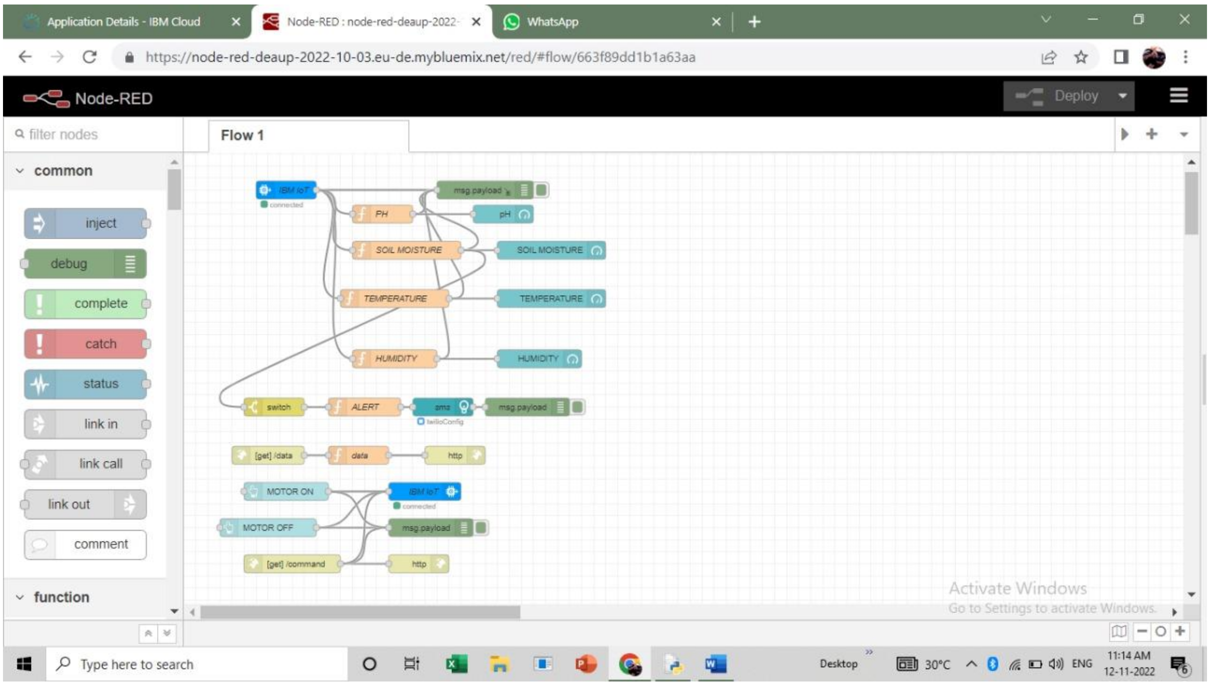
Web application dashboard:



Code for MIT app inventor :



Node red flow:



10.ADVANTAGES & DISADVANTAGES

Advantages:

- Monitoring weather parameters such as temperature, pressure, humidity, soil moisture remotely
- Controlling motors easily through buttons
- Alert farmers in case of low moisture • threshold values are set any anomalies will be reported to the farmer
- User friendly and efficient
- Low cost

Disadvantage:

- Sensors may sometime malfunction maybe inaccurate sometimes
- Farmer needs internet connectivity
- Farmer must have a phone and have basic knowledge to operate it.

11.CONCLUSION

Smart Farming and IoT-driven agriculture are paving the way for what can be called a Third Green Revolution. The Third Green Revolution is taking over agriculture. That revolution draws upon the combined application of data-driven analytics technologies, such as precision farming equipment, IoT, “big data” analytics, Unmanned Aerial Vehicles (UAVs or drones), robotics, etc. In the future this smart farming revolution depicts, pesticide and fertilizer use will drop while overall efficiency will rise. IoT technologies will enable better food traceability, which in turn will lead to increased food safety. It will also be beneficial for the environment, for example, more efficient use of water, or optimization of treatments and inputs. Therefore, smart farming has a real potential to deliver a more productive and sustainable form of agricultural production, based on a more precise and resource-efficient approach. New farms will finally realize the eternal dream of mankind.

12.FUTURE SCOPE

With the exponential growth of world population, according to the UN Food and Agriculture Organization, the world will need to produce 70% more food in 2050, shrinking agricultural lands, and depletion of finite natural resources, the need to enhance farm yield has become critical. Limited availability of natural resources such as fresh water and arable land along with slowing yield trends in several staple crops, have further aggravated the problem. Another impeding concern over the farming industry is the shifting structure of agricultural workforce. Moreover, agricultural labour in most of the countries has declined. As a result of the declining agricultural workforce, adoption of internet connectivity solutions in farming practices has been triggered, to reduce the need for manual labour. IoT solutions are focused on helping farmers close the supply demand gap, by ensuring high yields, profitability, and protection of the environment. The approach of using IoT technology to ensure optimum application of resources to achieve high crop yields and reduce operational costs is called precision agriculture. IoT in agriculture technologies comprise specialized equipment, wireless connectivity, software and IT services.

13.APPENDIX

Source Code:

```
import wiotp.sdk.device
import time
import os
import datetime
import random
myConfig = {
    "identity":{
        "orgId":"eneg3n",
        "typeId": "RASPBERRYPI",
        "deviceId": "80722"
        },
    "auth":{
        "token": "8072251864"
        }
    }
client=wiotp.sdk.device.DeviceClient(config=myConfig,logHandlers=None)
client.connect()

def myCommandCallback(cmd):
    print("message received from ibm iot platform: %s" %cmd.data['command'])
    m=cmd.data['command']
```

```
    if(m=="motoron"):
        print("motor is switched on")
    elif(m=="motoroff"):
        print("motor is switched off")
    print(" ")

while True:
    soil=random.randint(0,100)
    temp=random.randint(-20,125)
    hum=random.randint(0,100)
    myData={'soil_moisture':soil,'temperature':temp,'humidity':hum}

client.publishEvent(eventId="status",msgFormat="json",data=myData,qos=0,onPubli
sh=None)
    print("published data successfully: %s", myData)
    time.sleep(2)
    client.commandCallback = myCommandCallback
client.disconnect()
```

GitHub & Project Demo Link :

GitHub Link :

https://github.com/IBM-EPBL/IBM-Project-15964-1659606407.git

Project Demo Link:

https://youtu.be/iS6H3ui3X8k